The Adoption of Standard Time

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Despite some "originators' " claims, standard time was not adopted primarily to bring order to the chaos of railroad timetables.[1] Indeed, the railroads did not need standard time for their operations. Rather, in the 1870s scientific pursuits requiring simultaneous observations from scattered points became important, and those needs led to proposals for federal action in the early 1880s. In response to these pressures from scientists, railroad superintendents and managers implemented a standard time system on November 18, 1883, a system tailored to their companies' train schedules. Thereby they effectively forestalled any federal intervention in civil time for over thirty years.

As the railroads introduced standard time, most American cities collaborated, passing ordinances that shifted their civil times to the new system. In almost all large cities these shifts were small—a few

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[1] Accounts by the principals and their direct descendants include: William F. Allen, "Report on the Adoption of Standard Time," *Proceedings of the General Time Convention and Its Successor . . . the American Railway Association*, appendix (1893?): 702–3; William F. Allen, "History of the Movement by Which the Adoption of Standard Time Was Consummated," *Proceedings of the American Metrological Society* 4 (1884): 25–50 (hereafter cited as *PAMS*); William F. Allen, *Short History of Standard Time and Its Adoption in North America in 1883* (New York, 1904), 17 pp.; John S. Allen, *Standard Time in America: Why and How It Came about and the Part Taken by the Railroads and William Frederick Allen* (New York, 1951), 20 pp.; Charles F. Dowd, "Origin and Early History of the New System of National Time," *PAMS* 4 (1884): 90–101; Charles N. Dowd, *Charles F. Dowd, A.M., Ph.D.—a Narrative of His Services in Originating and Promoting the System of Standard Time* (New York, 1930), 32 pp.; Sandford Fleming, "Universal or Cosmic Time," *Proceedings of the Canadian Institute* 21 (July 1885): 5–24; and Truman Abbe, *Professor Abbe . . . and*

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0040–165X/89/3001–0004$01.00

minutes at most; and no citizen could discern any difference "before-and-after." The imperceptibility of the shift—actually a fundamental change in keeping civil time—led to standard time's immediate success, allowing its transformation from a specialized time—railroad time—to the time we live by.

Where the shifts in time were large, opposition arose. Though few in number and not organized, citizens in these locales blocked standard time's adoption. In fact, a dual time system continued in this country until 1918, when the federal government began to legislate civil time; and local option in time-system observance continued until 1967, when the federal government finally preempted all civil-time statutes. Even today, the United States' civil-time system is not uniform: About 3 percent of the population lives in areas that do not observe daylight saving time.[2] This continuing opposition to uniform

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the Isobars: The Story of Cleveland Abbe, America's First Weatherman (New York, 1955), pp. 143–51. For a comparison of Dowd's and Allen's claims, see Ian R. Bartky, "The Invention of Railroad Time," *Railroad History* 148 (1983): 13–22. In addition, there are numerous accounts, generally incorrect, in newspapers and magazines. The first published analysis is Robert E. Riegel, "Standard Time in the United States," *American Historical Review* 33 (1927): 84–89, which displays a general lack of understanding of the subject. There are two unpublished manuscripts: Barbara Liggett, "A History of the Adoption of Standard Time in the United States, 1869–1883," Master's thesis (University of Texas, 1960), 116 pp.; and Frederick Warner Allen, "The Adoption of Standard Time in 1883, an Attempt to Bring Order into a Changing World," Undergraduate Intensive Program (Yale University, 1969), 115 pp. The first one is almost entirely descriptive in nature. The second, by a descendant of the implementer of standard time, presents a view that *many* scientists and railroaders were involved in important ways in the adoption process; I do not agree with this view. The author also analyzes the public's opposition to standard time as a conflict with rural, traditionalist values. By considering the *effects* of the time change, opposition in places such as Detroit, Savannah, Pittsburgh, and cities in Ohio can be included with the "rural" regions, so I tend to reject his analysis. Contemporary analyses are Carlene E. Stephens, *Inventing Standard Time* (Washington, D.C., 1983), 24 pp., which accompanied the centennial exhibition at the National Museum of American History, Smithsonian Institution; and Ian R. Bartky, "Inventing, Introducing, and Objecting to Standard Time," *Vistas in Astronomy* 28 (1985): 105–11 (originally presented at the 1984 centenary of the Greenwich meridian). One additional analysis, Eviatar Zerubavel, "The Standardization of Time: A Sociohistorical Perspective," *American Journal of Sociology* 88 (1982): 1–23, contains many inaccuracies; see Ian R. Bartky, "A Comment on 'The Standardization of Time' by Zerubavel," ibid. 89 (1984): 1420–25.

[2] Ian R. Bartky and Elizabeth Harrison, "Standard and Daylight-Saving Time," *Scientific American* 240 (May 1979): 46–53. The methodology is in National Bureau of Standards Report "Review and Technical Evaluation of the DOT Daylight Saving Time Study, April 1976," *Hearing on Daylight Saving Time Act of 1976* (House of Representatives, Committee on Interstate and Foreign Commerce. Serial no. 94–109), pp. 125–351.

time stems from choices made over one hundred years ago when standard time was introduced.

Standard time's utility—its scheme of large regions having the same time, each region's time differing by integral hours—can hardly be overemphasized. It is lesser in technical areas, for meteorologists, astronomers, navigators, space-vehicle launchers, electric-power grid monitors, personal computer users, the armed services, and a myriad of others can and do take specialized times for their operations. Rather, standard time—a worldwide system coupled closely to the cycle of light and darkness that regulates our lives—helps the citizen who telephones long distance, tunes to a TV station in a nearby city, dates a legal document, and travels between cities and towns. Standard time has become our culture's time.

Railroad Time before Standard Time

A movement of one degree around the earth's surface—about 48 miles due east or west in the United States—changes local time four minutes. Local time implies a clock, one regulated to keep the mean solar time of a particular locale.[3] Railroads began in an era when precise time—when any time—had importance only in a few occupations. The engineers surveying the right-of-way and supervising the laying of track undoubtedly understood the positional consequences of local time. But it was simpler for the road's superintendent to take the time at one station and use it everywhere; a timetable was then merely a matter of adding a train's running time to its departure time.[4]

Benefits of a single time were known from the very first. In May 1834 the chief engineer of the South Carolina Canal and Rail Road Company reported difficulty in attaining regularity in the arrival and departure times of passenger trains running between Charleston and Hamburg, 136 miles away. The problem on this, the longest railway in the world, was caused by "the want of a uniform standard of time at the different [station] points." It was resolved "by placing clocks [at the six stations] . . . which being well-regulated and readily accessible to the Engineer and Agent, will enable them to regulate their movements on the road with great accuracy."[5]

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[3] Local time can be determined from a sundial within a minute, after corrections; however, a sundial displays *apparent* time. For a discussion of local noon, solar noon, the equation of time, and stellar time, see any astronomy text.

[4] This was a contrast to the early (pre-1840) English mail coaches, where the timepieces carried were adjusted so as to gain or lose in conformity with the local times. Humphry M. Smith, "Greenwich Time and the Prime Meridian," *Vistas in Astronomy* 20 (1976): 220, and Derek Howse, *Greenwich Time and the Discovery of the Longitude* (Oxford, 1980), p. 83.

Selecting a specialized time over local time by which to run a railroad was not radical—navigators kept Greenwich time, and astronomers used their own time systems. Fortunately, although a railroad could select any time it wanted, lines in one region tended to choose the same one. In November 1849, for example, New England railroads adopted the time of a meridian two minutes west of Boston as their standard for all clocks, timetables, and trains.[6] Consolidation of rail companies also contributed to the extension of such regional times.[7] By 1874, about 60 percent of the 431 North American railroads used the local time of one of ten cities. On the eve of standard railway time's adoption, the times of eight cities—New York, Chicago, Philadelphia, Columbus, Boston, Washington, Jefferson City, and Atlanta—were the operating times of 208 of the 316 railroads. Forty-one other cities' times served the rest.[8]

"Railroad time," then, was a group of unrelated times, a majority of lines using the local times of major cities. There was no "system." Like the rail lines, the different times touched or overlapped at 300 points in the country.

A Need for Uniform Railroad Time?

In 1832 the United States had only 229 miles of railway lines. By 1880, three years before standard time, the rail network had grown

[5] *Annual Report of the Directors of the South Carolina Canal and Rail Road Company* (May 6, 1834). I am indebted to Carlene Stephens for this reference.

[6] *Records of the New England Association of Railway Superintendents—April 5, 1848 to October 1, 1857* (Washington, D.C., 1910), p. 37. This choice seems to be the bisector of the New England section; it is not the Cambridge (Harvard College Observatory) meridian. The *use* of time was well understood by these officials—see their roads' operating rules; here, they were providing a consistent time base for the railroads in a region. Perhaps the first American railway association and predominantly technical in nature—sharing a library with the Boston Society of Civil Engineers—members considered many other issues, including patent infringement, freight and passenger regulations, signals, switches, wheels, brakes, comparative economy of coal and wood as fuels, and locomotive trials. The association had been founded by a number of New England's leading railroad pioneers, and it met regularly several times a year. Its active period was over by mid-1853.

[7] This was a process acting on the railroads from their earliest days. See W. J. Cunningham, "Railways (Railroad Consolidation)," *Encyclopaedia Britannica* (Chicago, 1913), p. 936.

[8] See Bartky, "The Invention of Railroad Time" (n. 1 above), pp. 18–20, for the identification of regional railroad time in the United States. In addition, each line's operating time system—an ensemble of "hardware" and "software"—had been developed on the basis of precision, *not* accuracy. The success of such relative systems, which

to 94,671 miles.[9] The growth rate suggests that any problem caused by multiple railroad times would have appeared somewhere and then continued—even spread—over the years. Yet, few discussions of multiple railroad times appeared anywhere, and the railroads' superintendents scarcely participated in them.

The first industry editorial appeared in mid-1852, after the network had reached 8,683 miles.[10] Arguing safety and efficiency in operations, the writer recommended that New York City time be telegraphed everywhere, as the "first [sole] meridian of railroad time." Five years later a comment on the lack of "Standard Railroad Time" emphasized the annoyance and confusion of multiple times to travelers. No other suggestions appeared until 1870—at 53,878 miles—when a writer proposed the "local time of some central city, [say] St. Louis" as the one by which to operate the railroads and all public affairs in the United States. By and large industry comment then ceased.[11]

On the other hand, astronomers, many of whose observatories provided time to the railroads, began to write about uniform time in the early 1870s.[12] Samuel Langley, then director of the Allegheny Ob-

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worked splendidly during the era of timetable safety and beyond, reinforced the railroaders' near-total lack of interest in uniform time. See Bartky, "Running on Time," *Railroad History* 159 (Autumn 1988): 18–38.

[9] Harry T. Newcomb, "Railways (the First Railroads)," *Encyclopaedia Britannica* (Chicago, 1943), p. 936, for the various mileages.

[10] The writer undoubtedly was reminded of the issue by the start of the important and famous telegraphic time-distribution system from the Royal Observatory, Greenwich. Howse, *Greenwich Time* (n. 4 above), p. 92; *The Times* (London), gives August 19, 1852 for the system's implementation date by George B. Airy, the seventh Astronomer Royal.

[11] Editors, "Railroad Time," *American Railroad Journal* 25 (August 21, 1852): 529–30. A "Comparative Time-Table" listing the local times of 102 cities and towns was printed in *Dinsmore's American Railroad Guide* in February 1857 and then reprinted with comments in the *American Railroad Journal* 30 (March 14, 1857): 163 (N.B.: This table is useless without a listing of railroad operating times). Then, Editors, "Time for the Continent," *The Railroad Gazette* 1 (1870): 6; followed over the next eight months by two responses and two minor items on uniform railroad time. There are two citations to industry journals from 1852 to 1860, none to 1870, and seven to 1881. (For much of the railroad literature see Elizabeth O. Cullen, "Standard Time—Proposals—Adoption—Regulation," Association of American Railroads, Bureau of Railway Economics Library [May 1957], 25 pp.) Finally, Editors, "Time for the Continent," *The Railroad Gazette* 15 (1883): 756, reminding its readers of the 1870 proposal.

[12] The earliest observatories transmitting time included Harvard College, Professor Bull's private one in New York City, Dudley in Albany, Michigan at Ann Arbor, U.S. Naval Observatory, Cincinnati, and Dearborn in Chicago. A few astronomers competed with jewelers, who also supplied time and services to the railroads. Samuel P. Langley, the most famous one, established his time service in 1869 to sell time to the Pennsylvania Railroad. For details, see Donald L. Obendorf, "Samuel P. Langley: Solar Scientist, 1867–1891," Ph.D. diss. (University of California, 1969), chap. 1.

servatory near Pittsburgh and later secretary of the Smithsonian Institution, was one such astronomer. For almost a decade he urged a "common 'railway time' for the country east of the Mississippi, doing away with all the discrepancies which perplex travellers, all the added trouble to the superintendents in preparing schedules, and all the facilities for making error."[13]

The U.S. Naval Observatory, public timekeeper since 1845, began promoting national uniformity in 1871.[14] In 1877 it (1) arranged to drop a time ball—an accurate, visual time signal for navigators and the public—at the Western Union Telegraph Company's New York City building, (2) offered the Washington noon signal to any town having over 20,000 inhabitants, and (3) urged that all railroads acquire its time signal daily, asserting, "in the opinion of many experienced and prominent railway-officials . . . it is . . . very desirable for all railroads to be operated by one common time."[15]

Most writers invoked England and its Greenwich time as a model—unfortunately, one that differed greatly from American reality.[16] Also, these industry journalists and astronomers could not have been aware of the extent to which railroads in a region had adopted one time or of the multiplicity of these regions. Had they been aware, they might have considered multiple time-zone systems.[17] In addition, many of these uniformity advocates invoked railroad safety to support their position of a single-time system for the United States. These writers did not understand their era's rail operations.

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[13] Samuel P. Langley, *Proposal for Regulating the Clocks of Railroads* (Pittsburgh, Dec. 1, 1869), p. 5. This eight-page pamphlet is in the Smithsonian Institution Archives, Record Unit 7003, Samuel P. Langley Papers, 1869–1906, Collected Writings of S. P. Langley nos. 1–68, 1869–82. Also, "On the Allegheny System of Electric Time Signals," *The American Journal of Science and Arts* 3d ser., 4 (1872): 386; "Uniform Railway Time," *The American Exchange and Review* 24 (1874): 272; "The Electric Time Service," *Harper's New Monthly Magazine* 56 (1877): 665–71, now emphasizing accuracy, not uniformity. The railroad industry knew of Langley's efforts: Editors, "Uniformity in Railroad Time," *The Railroad Gazette* 1 (April 9, 1870): 29.

[14] Ian R. Bartky and Steven J. Dick, "The First North American Time Ball," *Journal for the History of Astronomy* 13 (1982): 50–54. For the chronology, see Bartky, "Naval Observatory Time Dissemination before the Wireless," *Sky with Ocean Joined*, ed. Steven J. Dick and LeRoy E. Doggett (Washington, D.C., 1983), pp. 1–28, at the observatory's sesquicentennial in 1980.

[15] No citations accompanied this statement. Edward S. Holden, "On the Distribution of Standard Time in the United States," *Popular Science Monthly* 11 (1877): 180–81.

[16] Among them was Cleveland Abbe, writing in 1875; see Abbe, *Professor Abbe* (n. 1 above), p. 144. The model's obvious flaw was size—England and Scotland spanning thirty-seven minutes, while the United States spans nearly four hours. These writers also assumed that Greenwich time was the kingdom's legal time, but that was not true until 1880, when Greenwich *and* Dublin times were adopted. Indeed, in 1858 British courts had ruled for local times in civil cases. British railways began adopting a single time in 1840, the last lines converting by the end of the decade. Town councils along the lines immediately followed each railway's initiative. By August 1852, as the Royal Observatory began its telegraphic distribution of Greenwich time, one time for all purposes was already assured, and by 1855 98 percent of the kingdom's public clocks were displaying Greenwich time. So for the American advocates, the system was one time everywhere, the means were the railroads, and the only issue was which one time to select. For the British dates, but not their interpretation as given here, see Smith,

In 1847 Ybry (also Ibry), a French engineer, patented a way to construct "train sheets" or "time-table charts."[18] This graphic method, which superintendents trained as civil engineers introduced in the United States in the 1850s, "made the arrangement of [train] passing points a matter of *certainty* [emphasis added]."[19] The master of transportation and general superintendent plotted each train's travel and station stops and made adjustments so that slower trains ahead would not interfere with the faster ones. Then they adjusted schedules so that opposing trains would be on sidings when met. This method necessitated that *one* time be used; however, it could be *any* time. Scheduling for one railroad was not affected by other companies' choices.[20]

Additionally, perfecting schedules—from which the railroad's timetable is taken and printed—was no longer the means by which rail safety was being assured in the 1870s. Telegraphic control of train movements, used first in the United States in 1851, ended the timetable era around 1855.[21] Theretofore, tables and train rules provided a *time margin* of safety. Now, telegraphic orders delivered to the train

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"Greenwich Time and the Prime Meridian" (n. 4 above), pp. 220–22; and Howse, *Greenwich Time* (n. 4 above), pp. 86–92, 109–13.

[17] Data and a frequency analysis would have been necessary. The first tabulations were "Standards of Time," *Travelers' Official Guide of the Railway and Steam Navigation Lines of the United States and Canada*, October 1873 (hereafter *Travelers' Guide*); and ibid., February 1874, p. xxxii—a more complete one. See also Bartky, "The Invention of Railroad Time" (n. 1 above), p. 20.

[18] Editors, "Railway Time Tables," *American Railroad Journal* 47 (1847): 578.

[19] Henry S. Haines, *Efficient Railway Operation* (New York, 1919), pp. 384–87; and appendix 7, plates 1 and 2, table 15. On drafting the charts, see William Nichols, *Rule Four of the Standard Train Rules—Change of Time Table* (Los Angeles, 1910), p. 11.

[20] At boundaries, with passenger train connections, the solution was to hold "meetings of neighboring transportation-officials," from which came the various time conventions: Haines, *Efficient Railway Operation* (n. 19 above), p. 387. (Haines, a distinguished railroad manager, proposed a time-zone system for the railways in the southern United States in 1883.)

[21] Robert B. Shaw, *A History of Railroad Accidents, Safety Precautions and Operating Practices* (2d ed., Potsdam, N.Y., 1978), pp. 33, 118–20. Shaw also points out the expansion of telegraphs along rail lines by the time of the Civil War, with joint stations and telegraph offices.

conductors and engineers provided a *space interval* between trains.[22] A base time system was needed, of course. Once again, it could be *any* time the railroad wanted for its operations.

Having no need for uniform time, the superintendents of railroads never responded to its advocates. They continued expanding their individual rail networks, buying regional time from an authoritative source, the local astronomer, when they saw a benefit in doing so.

It was not safety but traveler confusion and inconvenience that created an interest in uniform time. In October 1869 Charles F. Dowd (1825–1904), president of Temple Grove Seminary for Women in Saratoga Springs, New York, presented a plan to a New York convention of trunk lines. His concern was with the rail traveler's confusion with multiple times: "These variations are governed by no general principle which would enable a person familiar with them in one locality, to judge of them in another. Any traveler, therefore, upon leaving home, loses all confidence in his watch, and is, in fact, without any reliable time."[23] Dowd proposed a "System of National Time" as the solution.

Dowd began with the idea of one time—Washington time—for the railroads, each city retaining its local time. As he calculated time differences for about 8,000 places along 500 rail lines, however, he realized that they varied dramatically from one minute to almost four hours. His correspondence with railway managers convinced him that differences greater than an hour were impracticable; "hour sections" was the result.[24] In 1870 he published a "Railway Time Gazetteer" that listed the railroads and their stations in terms of these hour sections, along with a color map showing the United States as four zones indexed to the Washington meridian.[25]

Dowd's map, the first of its kind, shows zone boundaries along meridional lines. Rather than "splitting" those railroads crossing the boundaries, Dowd instead carried the time of the adjacent zone to the lines' terminals. (This was an extremely practical solution, but surprisingly Dowd never mentioned it.) As a consequence of his plan, a few cities would have had three times: their own local times, and two railroad times—no different from several railroad terminal cities of that era. All places would have had at least two times.

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[22] Henry M. Sperry, "Railways (Railway Signalling)," *Encyclopaedia Britannica* (Chicago, 1943), p. 950. See also Haines's seminal study, "Railroad Accidents: Their Causes and Prevention," *The Railroad Gazette* 25 (June 30, 1893): 483–86, particularly his comments on time intervals, space intervals—the "true preventative" of rear collisions—and the various "block" systems.

[23] Charles F. Dowd, *System of National Time and Its Applications, by Means of Hour and Minute Indexes, to the National Railway Time-Table* (Albany, 1870), 107 pp.

[24] C. F. Dowd, "Origin and Early History" (n. 1 above), pp. 92–94. Dowd, unaware of the earlier railroad literature, wrote that prior to 1869 "no one had suggested, in this country, a meridian line to determine a standard time."

[25] A copy of Dowd's zone map appears on the cover of *Railroad History* 148 (Spring 1983).

At first several railroad superintendents' associations viewed Dowd's proposal favorably. But in 1873 they dismissed his system of four hour-difference time zones, now indexed to the Greenwich meridian, with the remark that "the disadvantages the system seeks to avoid are not of such serious consequences as to call for any immediate action on the part of railroad companies," and the recommendation that "the question of uniform standard national time for use on railroads be deferred until it more clearly appears that the public interest calls for it."[26] So the railroads rejected and then forgot a uniform time plan that was identical in principle and eventually identical in practice to the one they did adopt a decade later.[27] Dowd was forgotten as well.

These managers argued that the problem itself was not a major one for the traveling public, for "the great body [of them] travel only short distances, and to them the proposed uniformity is of little or no importance."[28] Indeed, multiple times affected a minority of the public: No problem existed for those travelers residing in the large cities—New York, Chicago, Boston, and so on—whose local times were being used by the regions' roads. Yet, for a traveler whose home city might use either a particular railroad's time or its own local time, there was some confusion. The solution was simple, however: Ask. [29] As a person took more trips, the solution became habit: One knew the problem existed, so one *always* asked. Even for that small fraction of the traveling public affected, the problem was manageable, and of little importance.[30]

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[26] C. F. Dowd, "Origin and Early History" (n. 1 above), pp. 93–97. An 1870 supporting testimonial is reproduced in C. N. Dowd, *Charles F. Dowd* (n. 1 above), plate 4. Responding to a Western & Southern Railway Association's critique, Dowd had shifted his four time-defining meridians. He prepared an appendix to his 1870 plan; a copy of this 1872 document can be found in the Allen Papers (n. 57 below). The managers' rejection was printed in *The Railroad Gazette* 5 (1873): 206.

[27] In 1877/78 Dowd prepared another plan: two zones indexed to the New York City meridian, with the rail lines assigned to the division level; *The Railway Superintendent's Standard Time Guide* (Saratoga Springs, N.Y., 1877), 18 pp.; and *The Traveler's Railway Time Adjuster* (Saratoga Springs, N.Y., 1878), 18 pp. The rail line boundary of this plan is virtually identical to the one between the central and eastern rail zones in Allen's 1883 plan. See Bartky, "The Invention of Railroad Time" (n. 1 above), p. 18. Ironically, when the industry was reminded of Dowd's 1870–72 plan in 1882, its description was incorrect. Edwin Hill, of the Boston & New York Air-Line, wrote in *Travelers' Guide*, April 1882 (p. li) that "the boundaries of the hour sections are too arbitrary and not well defined in practice," misunderstanding Dowd's meridional map for the cities' times and unaware that Dowd had taken the railroads' times into the adjacent zones.

[28] *The Railroad Gazette* (n. 26 above), p. 206.

[29] "To avoid disappointment, it is better to inquire at the hotel by what particular time," *Appleton's Railway and Steam Navigation Guide* (June 1857). Again, my debt to Carlene Stephens.

Not only did Dowd exaggerate this particular difficulty, he also pointed toward the wrong solution: local time for the cities and towns along the rail lines.[31] For the railroad's "invented" time—a time independent of location—had come into general use along the rail lines. This was simpler, as only one time was needed for all civil purposes. Now, a town's longitude sometimes did not square with its time, but who cared?[32] Discussion of uniform time ended in the mid-1870s despite the growth in travel and despite the growth of a transportation network that had spanned the North American continent in 1869 and was expanding everywhere. Those involved with the network—the builders and operators, industry editorial writers, astronomers, travelers—still used multiple times.

Cleveland Abbe, the American Metrological Society, and the Beginnings of the Adoption Process

It was the need for a uniform time system in geophysics—for simultaneity of observations—that led to the adoption of standard time in the United States. The event that highlighted this need was the aurora borealis of April 7, 1874. The adoption process began in May 1875 with a letter written by Cleveland Abbe.

In addition to his background as an astronomer, Abbe was a pioneer in the art of weather forecasting, having established a telegraphic system to collect simultaneous temperature, pressure, and wind observations from all over the country.[33] Abbe took charge of the U.S.

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[30] Public complaints concerned timetables so complex that inexperienced travelers could not read them, poor connecting train scheduling, overly optimistic departure and trip duration times, lack of sufficient train service, and lost luggage. There were no more than seven letters and editorials on travelers' problems in the *New York Times* between 1860 and 1875. The Railway Association of America's rejection of Dowd's efforts was reported in the public press, however: "there is now no public demand for such an arrangement," *New York Times*, May 15, 1873, p. 2, col. 1.

[31] Dowd had hoped to market a product, but he had only copyright protection (Dowd, "Origin and Early History" [n. 1 above], p. 93). Allen, "History" (n. 1 above), p. 26, noted that Dowd argued strongly in 1883 that "the proposition to abolish the use of 'mean local time' could not and should not be carried into effect."

[32] The wide use of the railroads' times was noted in 1870; "Time for the Continent" (n. 11 above), p. 6.

[33] Anon., "Cleveland Abbe," *Encyclopaedia Britannica* (Chicago, 1943), p. 12. His publications are given in W. J. Humphreys, "Biographical Memoirs of Cleveland Abbe, 1838–1916," *National Academy of Sciences Biographical Memoirs* 8 (1919): 489–508. Abbe

Signal Service's new meteorological functions in 1870, coming to this position from the directorship of the Cincinnati Observatory. In this role he has been deemed the "father of the weather bureau."

People across the United States—from Eastport, Maine, well into Dakota territory west of Minnesota—saw the spectacular and intense display of northern lights.[34] Responding to Abbe's request, twenty signal service offices and eighty volunteers submitted reports. From the raw observations Abbe tried to determine the aurora's height above the Earth—an unknown quantity then—and attempted correlations with concurrent weather observations and magnetic measurements. He wrote, "The errors of the Observers' clocks and watches and *even of the standards of time used by them* [emphasis added], are generally not stated . . . so that the uncertainty of this vitally important matter will be found to throw obscurity upon some interesting features."[35]

The volunteers were members of the corps of meteorological observers, a group established by the Smithsonian Institution late in 1847. The organization had just been transferred formally to the U.S. Signal Service. Their written instructions, not revised for at least twenty years, assumed that a locale's civil time was its local time and that a locale's time could be calculated from its longitude—relations no longer always true.[36] Their reports varied greatly in quality. Almost any re-

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had trained with the famous Russian astronomer, Otto Struve. He was also intimate with the techniques of American time distribution.

[34] Abbe's three reports are in *Annual Report of the Chief Signal Officer for 1874* (Washington, D.C., 1874), pp. 383–85, *Annual Report . . . for 1875* (Washington, D.C., 1875), pp. 367–74, and *Annual Report . . . for 1876* (Washington, D.C., 1876), pp. 301–10.

[35] Abbe in *Annual Report . . . for 1876* (n. 34 above), p. 304. Years later he recalled that "the numerous correspondents had used such a great variety of standards of time, many of which could not be identified at all . . . the words 'railroad time,' 'local time,' or 'standard time' seemed to have no definite meaning . . . [and] when several railroads passed near an observer it was really impossible to ascertain what particular railroad time was adopted." Abbe (anon.), "Standard Time in America," *Science* n.s. 22 (1905): 316. There had been prior, large-scale networks, but they were manned by trained observers. For the terrestrial magnetic network, begun by Gauss—who had initiated observatory efforts in 1834 and had founded the Magnetic Union of Göttingen to promote magnetic observations—the times for observations were agreed on beforehand, and each observatory was equipped with a transit and clocks to determine the time directly. A variety of time bases was used in the 19th century; e.g., Madras Observatory took its magnetic measurements on Göttingen time, its meteorological measurements on Madras (local) time, dropped its time ball on Greenwich (navigator's) time, and distributed civil (local) time.

[36] "The time of observations will be the mean time of each Station," and each of three observations was to be made at "the exact hour, fixed by a well-regulated watch." Arnold Guyot, "Directions for Meteorological Observations," Adopted by the Smithsonian In-

search scientist would not have wasted effort trying to identify and correct the exact time biases among the eighty sets of observations; a capable one would have tried to prevent such errors from happening again.

In considering the steps that Abbe took, it is important to note that his own observers—soldiers assigned to locations around the country—had been trained to observe in special sequences. Climatological observations were to be taken at local times consistent with the Smithsonian Institution's extant instructions to the volunteers; additional ones were to be taken at noon and at the exact hour of sunset; and three others, based on Washington mean time, were to be taken. Together, these formed the *simultaneous* set of observations that was telegraphed by cipher as rapidly as possible to the central signal service office for the development of the daily weather forecast. Abbe frequently emphasized the requirement for simultaneity in these observations, contrasting them with *synchronous* observations—those taken at the same local times across the country. Abbe, whose signal service clock had been telegraphing the U.S. Naval Observatory's Washington time across the country to his observers since 1871, controlled the accuracy and consistency of these official observations by a rigid system of instructions and inspections.[37] (How surprised and upset he must have been when he learned a few years later that a few of his own military observers had been using railroad times for the simultaneous observations!)[38]

Abbe had uncovered a previously unrecognized observational problem: Observers were obtaining their location's "mean time" from the railroad's clock—an accurate clock, but one showing railroad time. *Any* set of observations was fundamentally in error, for it was neither

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stitution for the First-Class Observers (Washington, D.C., 1850); reprinted with additions in *Annual Report of the Smithsonian Institution for 1855* (Washington, D.C., 1855), pp. 239–40; reprinted in *Smithsonian Miscellaneous Collections* (Washington, D.C., 1860), pp. 35–36.

[37] Regarding the data transmission rate, see *Annual Report of the Chief Signal Officer* from 1874 on. The electric telegraph had made simultaneous observations possible *and* useful; before, observations "taken at the same hour of local time" had been adequate, since they could not be utilized (transmitted) at once. *Annual Report of the Chief Signal Officer for 1879*, pp. 190–91.

[38] "In the new instructions to Signal Service observers no local times will be recognized but only the Washington time, as telegraphed from this office," *Annual Report of the Chief Signal Officer for 1880–81* (Washington, D.C., 1881), pp. 68–69. Then, "the uncertainties in the local standard of time used by our voluntary observers and in a few cases by our regular observers"; Abbe, "The Meteorological Work of the U.S. Signal Service, 1870 to 1891," *U.S. Weather Bureau Bulletin*, no. 11 (Washington, 1893), pp. 269–71.

synchronous nor simultaneous; and only with great difficulty could the observations be adjusted. Yet only local observers "who chance to be favorably located" could provide the sort of network needed for studies of "atmospheric electricity, auroras, thunder storms, earthquakes, [and] meteors."[39] Clearly, the issue of multiple times had to be resolved. Abbe's first step was to have new instructions prepared for the corps of volunteer observers. Next, he wrote to the American Metrological Society.[40]

This society, founded late in 1873 by a group of educators and government scientists, debated various uniformity issues. In his May 1875 letter to its president, Abbe urged "action by the Society to secure the adoption of a uniform standard of time." Responding, the society established the Committee on Standard Time and made Abbe chairman. On May 20, 1879, the committee's *Report on Standard Time,* the key document in the process leading to uniform time for the United States, was approved.[41] Abbe began the report with a discussion of accurate time, recommending that it be obtained from any one of several astronomical observatories. He continued with time uniformity, listing and charting the seventy-five standards used by the railroads, pointing out the advantages of a very much smaller number of standards. He urged the immediate adoption of no more than five for North America—to be known as "Railroad and Telegraph Time." The set, indexed to the Greenwich meridian and differing by one hour from each other, would be the first step toward the adoption of *one* national standard of time for the United States: a single meridian through the Mississippi Valley at six hours earlier than Greenwich.[42]

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[39] Abbe in *Annual Report . . . for 1876* (n. 34 above), p. 317; and in *PAMS* 2 (1881): 237. Because I am focusing on the North American adoption process, I have omitted a discussion here of Abbe's international activities from the early 1870s on, designed to achieve simultaneous, worldwide meteorological observations.

[40] In existence between 1873 and 1891(?), this society has been confused by most writers with the American Meteorological Society, founded in 1919. The American Metrological Society met twice a year in the rooms of the president of Columbia College (Columbia University), F. A. P. Barnard. Its uniformity goals are enumerated in *PAMS* 1 (1880): 5–6. The society served primarily as a means for publishing various tracts and reports, and more than one-third of the over 800 pages of its *Proceedings* are devoted to uniform time. Thus, this journal is one of two major contemporary sources, the other being the *Travelers' Guide.*

[41] The *Report* is in *PAMS* 2 (1880): 17–45. A draft had been prepared in December 1875.

[42] Abbe credited the astronomer and leading American mathematician Benjamin Peirce for suggesting these hour-difference meridians, which were adopted by the committee in 1875. Allen, corresponding with Abbe on this point, wrote that Peirce proposed them in 1873 or 1874. Allen, "Report on the Adoption" (n. 1 above), p. 702.

Abbe proposed that cities and towns discontinue the use of local time, adopting instead the time standard of their area's principal railroad. Implementation would come via the railroad and telegraph companies, which "exert such an influence on our every day life . . . that if they once take that step towards unification which they have been talking about for years, then every one in the whole community will follow."[43] He suggested two mechanisms: (1) that certain people be invited to join the society to help effect the changes, and (2) that the government be urged to take action so that the time would be legal for general use. He recommended for nomination several astronomers, the president of the Western Union Telegraph Company, and "Mr. W. F. ALLEN, Sec'y Gen. Time Convention of R. R. officials."

The society's pace was leisurely. Two years after approving the report, it had not even sent membership invitations to those who could help implement the time reform. But during this period Abbe's own pace quickened. In March 1880, he and Sandford Fleming began to correspond. Fleming, a Canadian railway engineer, was starting his campaign for the adoption of a prime meridian and a single, universal time for the world. Abbe wrote of his society's strategy: to have the railroad and telegraph companies "make a beginning, . . . [then] hammer away at our national congress and call for its action on the subject." In his correspondence with Fleming he suggested an international convention on time uniformity sponsored by the Canadian or American government—an idea that led to the International Meridian Conference in Washington four years later.[44] Fleming's writings and Abbe's report were sent jointly by the Canadian government to scientific societies in Europe, and international debate and recommendations intensified. Abbe continued his reform efforts during 1881, still emphasizing one time for studies of natural and atmospheric phenomena.

Over six years had passed since Cleveland Abbe had proposed time uniformity to the American Metrological Society. However, the society viewed its role as one designed to publicize and to debate, rather than as one hastening implementation. So in September 1881 Abbe sent the *Report on Standard Time* to the General Time Convention—a group of railroad officials involved in scheduling. He included two society circulars that he had prepared.[45] At the convention's October 1881 meeting, the issue was referred to the secretary, William F. Allen, who was asked to report at a future meeting.

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[43] While *literally* true, there had been fewer than ten printed comments by the railroad industry in twenty-seven years. It is amusing to observe that Abbe's almost three dozen citations in his *Report* are only to astronomers' writings and to annual reports of astronomical and magnetic observatories.

[44] Truman Abbe, *Professor Abbe* (n. 1 above), pp. 145–48, and in *PAMS* 2 (1881): 124, 166–74. Abbe's role in international activities has not been described; Fleming's activities are discussed briefly by Smith, "Greenwich Time and the Prime Meridian" (n. 4 above), pp. 223, 225–26; and by Howse, *Greenwich Time* (n. 4 above), chap. 5. Fleming's vehicle, the Canadian Institute (Toronto)—now the Royal Canadian Institute—and the American Metrological Society allied themselves in December 1880 (see *PAMS* 2 [1881]: 166, 174). They began representations to international societies as well as to their respective governments.

At the Eve of the Change

Twenty-seven months later, Allen wrote, "No communication or proposition on the subject . . . had previously come before . . . the Time Convention."[46] But, even as he wrote, nearly 600 railroads and most principal American cities were already using the new time system. One is struck by the rapidity of the change: Between the summer and winter schedules in the *Travelers' Guide* (a monthly compendium of timetables and listings of company officials), North America and its railroads changed from one time system to another. Events occurring during the eighteen months between October 1881 and April 1883 had made this change a certainty.

First, governments got involved. One astronomer, director of the time service at Yale and anxious to increase his observatory's revenues, had persuaded the Connecticut legislature in 1881 to enact a statute making New York City's local time the state standard. The first of its kind in the United States, this law affected the railroads, for they were required to display the time in their stations.[47] By early 1883 Connecticut's railroad commissioners were warning those not in voluntary compliance, threatening compulsory legislation.

In December 1881 the Naval Observatory had a bill introduced in the U.S. House of Representatives. The bill specified the Naval Observatory's Washington time for official uses; that is, the United States would have a national standard of time similar to ones that had been adopted by other countries. Railroads would be required to print this

[45] See Humphreys, "Biographical Memoirs" (n. 33 above), p. 191, where Abbe's references, nos. 78 and 88, are noted. They carry March dates and are in *PAMS* 2 (1881): 231–40, as well as *Travelers' Guide*, May 1881.

[46] Allen, "History" (n. 1 above), pp. 29–30.

[47] L. Waldo, "The State Time Service," *Annual Report of the Astronomer . . . of the Winchester Observatory of Yale College* 1 (1881): 22–27, and appendix, 36–38. Waldo had been in charge of the Harvard College Observatory Time Service. Abbe incorporated his 1877 brochure in the *Report on Standard Time*, as well as his 1878 canvass of Boston railroads, which did not favor time legislation. Those roads whose operations were tied to Boston time did not comply with the statute. See Sidney Withington, "Standardization of Time in Connecticut," *Bulletin of the Railway and Locomotive Historical Society* 46 (1938): 14–16; David F. Musto, "Yale Astronomy in the Nineteenth Century," *VENTURES Magazine of the Yale Graduate School* 8 (1968): 14–17.

time in their schedules and display it, "as a boon to travelers"—a false argument, as we have seen. Reported out by the Committee on Commerce, the bill died in July during floor debate.[48]

Further legislative action made the issue an international one. Cleveland Abbe, consistent with his plans and his position as a high-level government scientist, had drafted a resolution calling for an international conference. It was presented to Congress in May 1882 and referred to the House Committee on Foreign Relations.[49] Petitions to Congress from several groups, including the American Metrological Society, had been sent earlier. A joint resolution passed, and in August 1882 the president signed an act authorizing him "to call an International Conference to fix on and recommend for universal adoption a common prime meridian, to be used . . . in the regulation of time throughout the world." In October the State Department queried foreign governments, sending invitations fourteen months later.[50]

Simultaneous with these government actions were efforts in the scientific communities to resolve specific issues. Abbe had worked to establish the Committee on Standard Time of the American Association for the Advancement of Science (AAAS). Dominated by astronomers selling time to the railroads and cities, the committee first reported in August 1881. Although a majority of members favored one time, they were not unified, and their disagreements caused the AAAS to send only an informational letter to the General Time Convention's October 1881 meeting rather than one supporting Abbe's Mississippi Valley meridian. By the following August, the environment had changed, the astronomers had achieved consensus, and the AAAS appointed a committee to confer with those to be named as official delegates to the International Meridian Conference.[51]

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[48] The bill, "to provide for placing time-balls on custom-houses at ports of entry, and for other purposes" (47th Cong., 1st sess., *House Reports*, vol. 3, no. 681, 5 pp.), was also the U.S. Naval Observatory's counter to Abbe's steps to provide time services, most recently via his agency's October 1881 *Information Relative to the Construction and Maintenance of Time-Balls* (U.S. Signal Service, Professional Paper no. 5, Washington, D.C.). This squabble between the two services erupted publicly early in 1882. Charges flew, an official complaint was made, and the U.S. Signal Service was ordered to cease time-service activities.

[49] See n. 44 above, and Humphreys, "Biographical Memoirs" (n. 33 above), pp. 495–96 (Abbe no. 101). See also *Congressional Record*, 47th Cong., 1st sess.

[50] *Proceedings of the International Meridian Conference*, U.S. House of Representatives, 48th Cong., 2d sess., Ex. Doc. no. 14 (Washington, D.C., 1884), 117 pp.

[51] See *PAMS* 2 (1881): 176. The letter itself is in *Proceedings of . . . the American Railway Association* appendix (1893?), p. 683. See also Committee on Standard Time, "Preliminary Reports," *Proceedings of the American Association for the Advancement of Science* 30 (1882): xvi, 4–6; ibid. 31 (1883): 633–34.

That the attitude was different from August 1881 is evident from the results of a questionnaire from the American Society of Civil Engineers, to which the nation's timekeepers—the observatory directors—and others responded early in 1882. The directors now favored a multizone system for the United States.[52] It seemed as if they had started to consider the actual implementation of a new time system and its effect on their services to the railroads and cities. Those writing in the science journals had been pointing out that a railroad was not primarily a specialized customer, like scientific and navigational users; its time had a strong public component.[53] Going further, the directors realized that if the railroads—and the country—adopted a multizone time system, then time adequate for many scientific needs could be derived from the system. Time signal accuracy, the directors' responsibility, would be enhanced, since the various signals could be compared and averaged more easily.[54]

The questionnaire itself, developed by Sandford Fleming as part of his parallel campaign for world time reform, supported his new strategy: the adoption of a prime meridian by governments, followed by a convention of *all* interested parties—scientists, railroaders, chambers of commerce, and any others throughout the United States, Canada, and Mexico—to determine a "system for regulating time . . . in North America." Fleming, still allied with Abbe and the American Metrological Society, proposed his strategy at the AAAS August 1882 meeting.[55]

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[52] Ten scientists associated with time services are included in the hundred-odd responses to Fleming's questionnaire (n. 55 below). The five nongovernment-observatory directors favored four meridians for the United States. The U.S. Naval Observatory continued to urge the adoption of the Washington meridian; the U.S. Signal Service, the Mississippi Valley meridian. Simon Newcomb, superintendent of the Nautical Almanac Office, was in favor of multiple zones, suggesting that Washington or New York be used as the base meridian. (See also Simon Newcomb, *The Reminiscences of an Astronomer* [Boston, 1903], pp. 225–26.)

[53] Edward W. Morley, "On a System of Standards of Time for the Whole Country," *Journal of the American Electrical Society* 4 (1879): 102–6; Leonard Waldo, "The Distribution of Time," *Science* 1 (1880): 277–80; Edward S. Holden, "Astronomy," *Annual Report of the Board of Regents of the Smithsonian Institution . . . for the Year 1881* (Washington, D.C., 1883), p. 228.

[54] Intercomparisons of telegraphic time signals had been showing discrepancies of up to several seconds. Solutions—in particular U.S. Signal Service ones—were being advanced.

[55] Sandford Fleming, "Standard Time for the United States of America, Canada and Mexico," *Letter to the President of the American Society* [*sic*] *for the Advancement of Science* (Montreal, August 1882), 44 pp. This document includes the responses to the American Society of Civil Engineers' questions. (Fleming's interest began in the 1870s with twenty-four-hour time—to reduce timetable confusion.)

Scientists in other disciplines were in favor of the adoption of the Greenwich meridian. International scientific communities, continuing the now decade-long process to adopt a uniform system, discussed the issue at the Third International Geographical Congress in September 1881 and planned for it at the seventh General Conference of the European Geodetic Association in October 1883.[56] Though less involved in American public arenas and not focused primarily on time, such scientists provided support to the movement in early 1882 by memorializing Congress with regard to the International Meridian Conference.

By mid-1882—after several months of public discussions among scientists and some discord among astronomers affected most directly by the proposals—a consensus had been achieved. Moreover, during this period those scientists who wanted uniform time were succeeding via a new means: influencing national governments. Any observer would have concluded that a uniform time system was only a few years away.

In the events just outlined the railroads were, at most, minor participants. Yet by the period's end the railroads were the major participants, controlling the adoption process. This change was due to William F. Allen and what he did over twenty-three months.

The railroad's involvement began in October 1881 after a scientist (Abbe) sent his report to a group of rail transportation managers. Superficially, its contents were of no importance to them. Indeed, the American Metrological Society's circulars had already been printed without comment in the editorial pages of the *Travelers' Guide*. Then, in early December, Allen happened to learn of his now two-and-a-half-year-old nomination to membership in the society, an invitation apparently never sent.[57] He attended the December meeting, at which Abbe's Committee on Standard Time reported on science-organization achievements and government-agency actions that were leading to time reform. In January, Allen wrote the railroad industry's first comments in a decade in the *Travelers' Guide.* Over the next two years, almost every issue carried some mention of uniform time.[58]

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[56] George M. Wheeler, *Report upon the Third International Geographical Congress and Exhibition at Venice, Italy, 1881* (Washington, D.C., 1885), pp. 23–29. Wheeler, U.S. Army Corps of Engineers, included a lengthy bibliography (to June 1885), compiled by the uniformity advocates, and discussed two other scientific conferences: the seventh General Conference of the European Geodetic Association held in Rome in October 1883, and the International Meridian Conference held in Washington in October 1884; ibid., pp. 32–38.

[57] William F. Allen, Papers on Standard Time, New York Public Library, Letters Sent, vol. 1, December 6, 1881, to the society: "My attention has been called today for the first time to the mention of my name on page twenty-nine of the published Proceedings of the Society issued in 1880." Allen, December 7, 1881, to Professor Cleveland Abbe: "Only yesterday I became accidentally aware that my nomination to membership . . . in 1879 was made in the Report of your Committee. . . ." Allen (1846–1915) is listed in the *Dictionary of American Biography.*

William F. Allen, a railway engineer by training, was in a unique position. Permanent secretary of the railroads' General Time Convention (1872–85) and its minor companion, the Southern Railway Time Convention (1877–85), he was a key member of the only railway groups in existence able to consider time reform. The General Time Convention's members were general managers and superintendents of the major eastern rail lines, and it had been established "to settle questions of running time for through trains."[59] Time uniformity became the convention's first nonscheduling issue.

In addition, Allen had the means to influence the industry: He edited the *Travelers' Guide,* which included a short editorial section. Also, his membership in the American Metrological Society gave him an insider's view of the steps influential people—ones in no way connected with his profession—were taking to secure a uniform time system. Clearly, he judged that they were succeeding.

Ironically, just when the railroads should have been involved in the issue as a group, they were split. A rate war among the trunk lines continued through April 1882, the month set for the General Time Convention's spring meeting. Allen, who had solicited information and might also have already prepared his own plan for this meeting, announced its indefinite postponement in the *Travelers' Guide.*

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[58] This was a marked contrast to the railroad industry's prior interest (see n. 11 above). Then, in 1883, during the April-through-November adoption period, five railroad weeklies printed forty articles; Allen, "History" (n. 1 above), p. 49.

[59] The history of timetable harmonization groups prior to the 1870s is scarcely known. Haines, an early participant, stated that they grew from meetings of neighboring railroad officials, the need being caused by the railroads' expansion after the Civil War. Convenience accrued by organizing the General and Southern Time Conventions and making changes twice yearly (Haines, *Efficient Railway Operation* [n. 19 above]). Yet, Dowd's meetings with other conventions and associations in the late 1860s suggest the existence of other scheduling groups, and the railroads had run under winter and summer schedules for decades, so Haines may simply be recounting the history of a successor: the two conventions' merger as the General Time Convention (1886), then its renaming as the American Railway Association (1891)—now the Association of American Railroads (AAR). Allen's details provide no additional insight; Allen, "History" (n. 1 above), pp. 30–31; and *Travelers' Guide*, September 1881, p. xix. In April 1891 Haines, then the General Time Convention's president, noted that his organization for years had "so completely ceased to act upon time-table matters that its title had become a misnomer." *Proceedings of the General Time Convention and Its Successor the American Railway Association* 1 (1886–93): 372. Different from timetable harmonization, with its obvious economic component, was the New England Association of Railway

Government action and consensus building outside the industry progressed. The rate war ended. In October 1882 the General Time Convention held a truncated meeting, at which there was talk of disbandment. Allen told those assembled of his conclusions regarding uniform time, undoubtedly discussed the outside events, and induced the convention to call for a meeting April next, specifically to discuss his report on standard time.

Differing from the industry's now-modest interest in and mild approval of legislative time reform, Allen's April 1883 editorial in the *Travelers' Guide* and his report to the General Time Convention urged immediate industry action: "We should settle this question among ourselves, and not entrust it to the infinite wisdom of the . . . State legislatures."[60] Nor was he sanguine about Congress, writing later in the fall that "Congressional action . . . is to be depreciated, as . . . there is little likelihood of any law being adopted in Washington, effecting [*sic*] railways, that would be as universally acceptable to the railway companies."[61]

Superintendents' 1849 adoption of a regional time standard (n. 6 above). I consider this adoption part of the railroads' systematization processes, tracing codification—the AAR's Standard Code of Railroad Operating Rules, adopted in 1887—back through (probably) other, pre-1870 regional associations to the New England Association and then to the roads' separate sets of operating rules, some of which were first published in the 1830s. (In addition, an Association of Railroad Superintendents began around 1881 and continued at least through 1886. It, too, was involved in standardization issues; e.g., train signals, code of train rules. Unfortunately, after 1882 its meetings were held in secret; *The Railway Age* 7 [1882]: 228, 599.)

[60] Allen emphasized the Connecticut Railroad Commissioners' warning in both documents: "*As the neglect . . . to comply causes three kinds of time to be now in use in New London by the railroads centering there . . . it is hoped that . . . the companies will find it for their interest . . . to make, at an early day, such changes . . . as will make them conform to the uniform time established by law.*" He also remarked, "If we agree that the system . . . here proposed is the one best adapted for practical use on our railway lines . . . whether it conforms to the whims of 'the ruling classes' who run our legislatures." On the other hand, *The Railway Age* editors, briefly noting Sandford Fleming's American Society of Civil Engineers questionnaire, termed this attempt to establish uniform time "timely" and viewed the American Metrological Society's memorial to Congress for the establishment of standard time as a "movement in the right direction." *The Railway Age* 7 (1882): 253, 323.

[61] Allen Papers (n. 57 above), Letters Sent, 1:293; to Michigan Central Railroad. Allen's first remarks at the October 1884 International Meridian Conference (n. 50 above), pp. 57–58, can also be viewed in terms of continuing concern for government intervention, for he urged there that no change be made in the Greenwich-based meridians just adopted by the railroads, presenting a strong statement from the General Railway [*sic*] Time Convention. (Howse, *Greenwich Time* [n. 4 above], p. 144, apparently mistakes Allen's discussion as associated with counting from the prime meridian.)

So the railroads began to care about uniform time because of the actions of one person, uniquely placed to appreciate the efforts that had been under way for years and able to effect change, who felt that the industry had to respond to prevent "outsider" influence.[62]

[62] Allen's attitude toward government intervention was typical of many railroaders of this era. One need only read their trade journals' responses to the Granger rate-control legislation of the farming states, the East's Anti-Monopoly League activities, the New York State legislative hearings, and the first attempts by the federal government to legislate railroad matters to conclude that many felt under siege; and they responded in kind. See, e.g., P. Harvey Middleton, *Railways and Public Opinion—Eleven Decades* (Railway Business Association, Chicago, 1941), chap. 5, "State and Federal Regulation." Yet, other industry spokesmen held different views. These ranged from positive feelings toward (many) state railroad commissions, to calls for federal regulation of interstate affairs—Charles Francis Adams, Jr., of the Massachusetts Railroad Commission being the one cited most often for his statesmanship and thoughtful comments in this area. See Editors, "What Do the Railways Want?" *The Railway Age* 7 (1882): 324–25, 329; and T. M. Cooley, ed., *The American Railway* (New York, 1888). A time standard is not a revenue or traffic subject—issues that caused immediate differences in opinion among railroaders and the general public. Rather, it is in the class that includes color-blindness testing, brake standards, automatic couplers, train signals, operating rules, signal-glass color uniformity—issues that lead usually to differences in practice and scarcely of dominant interest to the public. All these issues were considered in this two-year period while uniform time was before the industry. Some of them came from state railroad commissions, whose regulatory statements were often viewed positively by the trade press. For example, the Ohio railroad commissioner, seconding statements of need by the U.S. commissioner of railroads and *The Railway Age* editors, asserted the existence of "an opportunity for railroad superintendents to meet in convention" and develop uniform signals, writing, "A national standard signal code is a desideratum." Further, its development "should be enforced by law if not voluntarily adopted" (*The Railway Age* 7 [1882]: 730). Other issues were resolved by the industry without government suggestion or intervention; see George R. Taylor and Irene D. Neu, *The American Railroad Network—1861–1890* (Cambridge, Mass., 1956), for the details of the decades-long process to achieve railway-gauge uniformity. Still other issues required federal law (the Railroad Safety Appliances Act of 1893) to effect complete change—here, examples are air brakes and automatic couplers. That Allen tied a time standard—essentially a nonrailroad issue prior to his interest and of a class often seen as only a technical matter—to the threat of regulation was more than simply "warming up his audience." In 1883 the General Time Convention was still a "trunk lines" association, and these roads had been attempting to stabilize their pool—their voluntary, pro-rata sharing of revenues (forbidden after 1887 with the enactment of the Interstate Commerce Act). Indeed, the convention's proposed disbandment in 1882 was seen as a means to reduce pool-member conflicts. Allen probably did not recognize the noneconomic nature of time standardization in 1883; instead, he saw it allied with through train scheduling and revenues. With the General Time Convention's enormous successes—uniform time standard, uniform train signals, uniform code of train rules—in hand by 1890, demonstrating the strength of the administrative mechanisms that had been developed, this association's policy was clear: "Avoid any subject relating to traffic or revenue, and . . . confine . . . [activities] to matters of operation and economy." *Proceedings of the General Time Convention and Its Successor the American Railway Association* 1 (1886–93): 270.

Allen's Plan

On April 11, 1883, the General Time Convention met in St. Louis specifically to consider Allen's short report on standard time,[63] emphasizing feasibility and accompanied by two maps, the first depicting in color the overlapping nature of the forty-nine railroad times in use, the other depicting the rail lines in terms of five times.[64] The visual contrast was enormous; the touching and crossing points had been reduced from nearly three hundred to approximately forty.

Remarking frequently that his focus was on railroads and on solutions in terms of the railroads' needs, Allen discussed his clustering of the rail lines. First, he had placed ten of the most widely used (i.e., regional) standards into an eastern set and a midwestern one. Next he had located the geographic end points of the railway lines in each set, and had determined the mean or central meridian of each pair of extremes, finding that "the central meridians for the eastern and [mid]-western systems are almost exactly one hour apart." He proposed that these two meridians be located precisely one hour apart, and then defined three others, exact hours away from this pair, to encompass the remaining 20 percent of the North American railroads. Thus the concept of one-hour differences for time zones was affirmed.

Allen enumerated the cities and towns where the one-hour time changes between the sections would occur, having located them "where they change at present, and at the terminus of a road, or at least at the end of a division." By doing so, he could assure his audience that his proposal would lead "to no practical difficulty whatever in the construction of time-tables."

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[63] Allen, "Report on Standard Time," *Proceedings of the General Time Convention and Its Successor . . . the American Railway Association*, appendix (1893?), pp. 690–92.

[64] Allen, "Report on Standard Time" (n. 63 above), pp. 690, 692. Copies of the "before" map were sent to all railway managers in a pamphlet on August 30, 1883, and other copies were on sale by the *Travelers' Guide* 16, November 1883, p. xliii. Only the original used in Allen's 1883 presentation is still available—a gift to the Smithsonian Institution, and exhibited by the National Museum of American History at the centennial exhibit in 1983–84. See also Allen, "Report on Standard Time" (n. 63 above), facing p. 702; *PAMS* 4 (1884), facing p. 230; and *Travelers' Guide* 16, November 1883, p. 536. Other "after" copies, including the large-scale original also used by Allen in April 1883, are in the Allen Papers (n. 57 above). The 1883 copyright maps (large-scale) are at the Map Division of the Library of Congress. The American Railway Association map is reproduced in color in Bartky and Harrison, "Standard and Daylight-Saving Time" (n. 2 above), p. 48. The various maps differ, particularly in the mountain/central zone boundary, reflecting some of the dynamics during the adoption period. In the November 22, 1883, issue of *The Railway Age* the editors published, on p. 143, a map from the *Chicago Tribune* showing the "new zones." Unfortunately, the zones are depicted incorrectly, completely obscuring their extent. It is this map that was used in Carlton J. Corliss, *The Day of Two Noons* (Washington, D.C., 1953), and then in Howse, *Greenwich Time* (n. 4 above), p. 125. The time zones prior to the federal government's intervention in 1918 are shown in a map, F. R. Moulton, "Time," *Popular Astronomy* 12 (1904): 398. After 1918, official maps prepared by the National Bureau of Standards for the Interstate Commerce Commission, and since 1968 by the Department of Transportation, are available.

Not surprisingly, the General Time Convention adopted Allen's report and proposal unanimously. As secretary, he was directed "to endeavor to secure the acquiescence of all [railroad] parties to the plan proposed" and to report at the next meeting. Two issues transcended the railroad managers' narrow interests. First, breaking with the tradition of selecting a national meridian for time purposes, Allen had referenced his system to Greenwich, a choice still under debate among scientists. Indeed, as several opponents had pointed out, there was no reason to base a time system for rail operations in America on the location of an English observatory.[65] Allen claimed the desire for Greenwich did not influence his choice. Rather, his clustering of the rail lines had led to an interesting result, or as he termed it, "a curious fact": The central meridian for the eastern section coincided (within six seconds) with the seventy-fifth meridian west of Greenwich—*exactly* five hours away.[66]

Since almost any mideastern city could have been chosen, one might suggest an extremely fortunate accident of geography.[67] Nevertheless, Allen's selection accomplished two immediate objectives. It completely removed intercity rivalry as an issue, and his choice gave him the support of the scientific community, particularly his fellow American Metrological Society members. While not necessary when he was working only with the railroad industry, such support became extremely useful as American cities began considering the railroads' system.[68] Conversely, the North American railroads' "acceptance" of Greenwich—its first international use as a land time standard—was invaluable to the uniformity activists.[69]

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[65] For example, Simon Newcomb, answering the questionnaire (n. 52 above): "See no more reason for considering Europe in the matter than for considering the inhabitants of the planet Mars."

[66] Allen, "Report on Standard Time" (n. 63 above), p. 691; and "History" (n. 1 above), p. 34. This averaging to locate a mid-meridian is not unusual: the New England railway managers likely used it in 1849 (n. 6 above); Sweden's 1879 national meridian for railroads was chosen to bisect the populated region of the country; and in a forgotten, February 1874 *Travelers' Guide* editorial discussion, Allen had used the identical process.

[67] Montreal (73.5° W), New York (74.0° W), Philadelphia (75.1° W), Ottawa (75.7° W), and Washington (77.0° W). Dowd, who had an identical plan, chose New York; Bartky, "The Invention of Railroad Time" (n. 1 above), p. 16. Amusingly, Atlanta replaced Detroit as the westernmost city in the eastern section a few weeks later, so Allen's "central" meridian should have also changed.

[68] Particularly in New York and Boston. In Boston, the clocks had to be retarded sixteen minutes to be on the new standard, and the northeastern railroads would accept the new time system only if the city changed. The astronomers at Harvard College Observatory were instrumental in convincing the local government.

On the second nonrailroad issue—cities' local times—Allen asserted that systems of hour difference standards led to maximum time differences of no more than "about thirty minutes," argued that numerous such cases already existed "without detriment or inconvenience to any one," and implied that his system was identical to the theoretical ones just described. He suggested having one's watch equipped with a second pair of hands, "if local and standard time *must* both be kept." However, he predicted that, should the railroads adopt the new system, "local time would be practically abolished." Actually, Allen's system was not a theoretical one. Its central zone was nearly two hours wide, and the two major zones overlapped along the Pennsylvania and New York shores of Lake Erie. Still, these anomalies were more than satisfactory to the railroads, and a city's problem was not a railroad concern.

Implementation

Late in August, Allen sent 570 railroads a detailed circular and maps, asking each for a decision on the new time system. At the General Time Convention's October 11 meeting in Chicago, he announced that roads representing 79,041 miles of trackage favored the change.[70] The convention set the conversion moment for noon on Sunday, November 18, 1883, a date consistent with their usual schedule changes.

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[69] As late as October 1883 the international scientific organizations still viewed the railroads' time as a specialized (Greenwich) one, with countries themselves remaining with "local and national hours, which shall necessarily be employed in civil life." Wheeler, *Report upon the Third International Geographical Congress* (n. 56 above), p. 35. This fundamental change to an international system for national, civil purposes has been overlooked completely because of Allen's zeal for his plan and his misreading of the character of time reckoning in his era. First, in *Travelers' Guide* 16, September 1883, p. xxxi, he gives January 13, 1848, for Great Britain's adoption of Greenwich time, misquoting from a time-change protest in *Blackwood's Edinburgh Magazine* ("Greenwich Time," 63 [March 1848]: 354). The date—simply part of the British railway-town adoption processes of the 1840s and 1850s—has been cited often, even in the scholarly literature (e.g., Riegel, "Standard Time in the United States" [n. 1 above], p. 84), thereby perpetuating the error. See also Smith, "Greenwich Time and the Prime Meridian" (n. 4 above), pp. 221–22, who termed it a "mystery"; and Howse, *Greenwich Time* (n. 4 above), pp. 145, 154, whose table 3 begins with it. Allen stated at the International Meridian Conference (n. 50 above), pp. 79, 80, that Sweden adopted Greenwich plus one hour for its meridian on January 1, 1879—a date before the North American railroads, and before Britain (1880)! In reality, the meridian was a national one indexed to Stockholm; Sweden adopted the Greenwich meridian in 1900. Howse, *Greenwich Time* (n. 4 above), pp. 145, 152–154, esp. his table 3—Priority of Adoption—is thus obscured. (I am indebted to correspondence with Derek Howse to resolve this matter. Swedish reference citations [my thanks to G. Pipping, Royal Swedish Academy of Sciences] are Jöran Ramberg, *Populär Astronomisk Tidskrift,* 1954, 1958.)

By November 18, everything was ready. Allen had distributed translation tables for converting the railroads' operating times to Greenwich-meridian times, to speed and simplify the conversion process for those schedules that were being changed. Those roads whose new times would differ ten minutes or fewer from their former ones planned no schedule changes, only changes to their clocks. Some roads planned to have their trains stop completely during the "extra minutes." The observatories disseminating time issued detailed information as well (figs. 1, 2).

Allen, who witnessed the change to the new time at the Western Union Building in New York City, described the event: "Standing on the roof of that building . . . I heard the bells of St. Paul's strike on the old time. Four minutes later, obedient to the electrical signal from the Naval Observatory . . . the time-ball made its rapid descent, the chimes of old Trinity rang twelve measured strokes, and local time was abandoned, probably forever."[71] Standard railway time began.

Writers described November 18 as the "day of two noons,"[72] as it was in the eastern parts of each new "time belt," the name being given to a zone. Sandford Fleming pointed out that "a noiseless revolution was effected throughout the United States and Canada."[73] Others noted later than no train accidents occurred on that day; the change had gone smoothly for the railroads. Chicago and its railroads changed to the new time in December. By an Act of Congress, Washington, D.C., adopted standard time in March 1884. And the state of Connecticut changed its statute to conform to the new time.

Why Object?

Changing to a new way of reckoning time was simple: Advance or retard your clock *n* minutes. So New Yorkers retarded their clocks four minutes; Washingtonians advanced theirs eight; Chicagoans stopped their clocks for nine minutes; and Philadelphians, New Orleaners, and Denverites did nothing. By April 1884 Allen was re-

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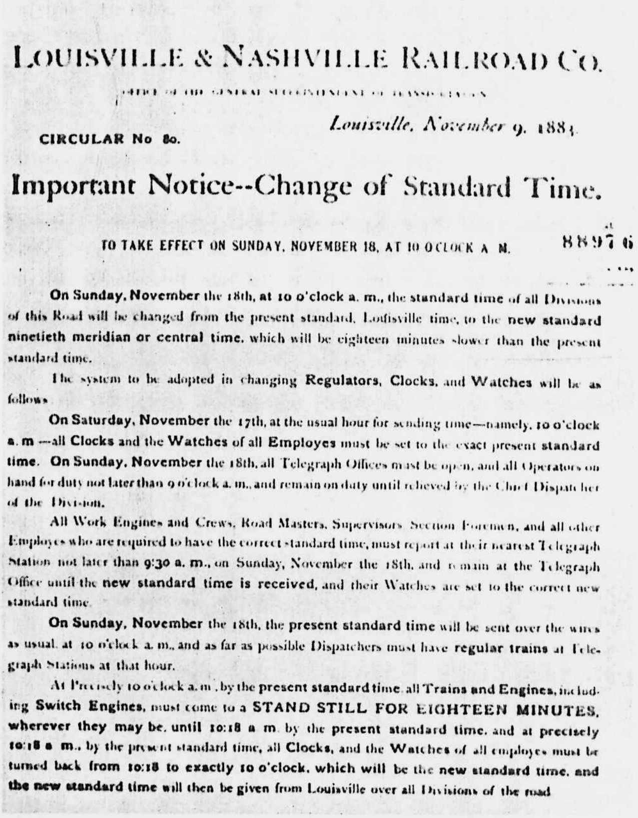
[70] Of the convention's members, the vote was thirty-three roads totaling 27,781 miles in favor, two roads totaling 1,714 miles against, and two abstentions. A few of the northeastern roads changed to the eastern standard on October 7, before the convention met. See Allen, "History" (n. 1 above), p. 44, and in the Allen Papers (n. 57 above).

[71] Allen, "Report on the Adoption" (n. 1 above), p. 703.

[72] For example, Corliss (n. 64 above).

[73] Sandford Fleming, "Time-Reckoning for the Twentieth Century," *Annual Report . . . Smithsonian Institution . . . for the Year Ending June 30, 1886* (Washington, D.C., 1889), p. 357.



LOUISVILLE & NASHVILLE RAILROAD CO.

Louisville, November 9, 1883.

CIRCULAR No 80.

Important Notice--Change of Standard Time.

TO TAKE EFFECT ON SUNDAY, NOVEMBER 18, AT 10 O'CLOCK A. M.

88976

On Sunday, November the 18th, **at 10 o'clock a. m.,** the **standard time** of all Divisions of this Road will be changed from the present standard, Louisville time, to the **new standard ninetieth meridian or central time,** which will be eighteen minutes slower than the present standard time.

The system to be adopted in changing **Regulators, Clocks,** and **Watches** will be as follows:

On Saturday, November the 17th, at the usual hour for sending time—namely, **10 o'clock a. m**—all **Clocks** and the **Watches** of all **Employes** must be set to the exact present **standard time.** **On Sunday, November** the 18th, all Telegraph Offices must be open, and all Operators on hand for duty not later than 9 o'clock a. m., and remain on duty until relieved by the Chief Dispatcher of the Division.

All Work Engines and Crews, Road Masters, Supervisors, Section Foremen, and all other Employes who are required to have the correct standard time, must report at their nearest Telegraph Station not later than **9:30 a. m.,** on Sunday, November the 18th, and remain at the Telegraph Office until the **new standard time is received,** and their Watches are set to the correct new standard time.

On Sunday, November the 18th, the **present standard time** will be sent over the wires as usual, at 10 o'clock a. m., and as far as possible Dispatchers must have **regular trains** at Telegraph Stations at that hour.

At Precisely 10 o'clock a. m., by the **present standard time,** all **Trains and Engines,** including **Switch Engines,** must come to a **STAND STILL FOR EIGHTEEN MINUTES, wherever they may be, until 10:18 a m.** by the **present standard time,** and **at precisely 10:18 a m.,** by the present standard time, all **Clocks,** and the **Watches** of all employes must be **turned back from 10:18 to exactly 10 o'clock, which will be** the **new standard time,** and **the new standard time** will then be given from Louisville over all Divisions of the road.

FIG. 1.—Example of the broadsides sent to employees detailing the required precautions as the railroads changed their operating times to standard time. (Courtesy the New York Public Library—W. F. Allen Collection.)

porting that seventy-eight of the hundred principal American cities had adopted the new time. The public's attitude confirmed the prediction made as standard time began: "In a short time the new standards will be accepted everywhere . . . and then all intelligent persons will ask why the change was not made years ago."[74]

But some opposed the change. The intensity of opposition, diffuse and scarcely reported in the country's newspapers, caused nonuniformity in time to continue, albeit from a different perspective. Ban-

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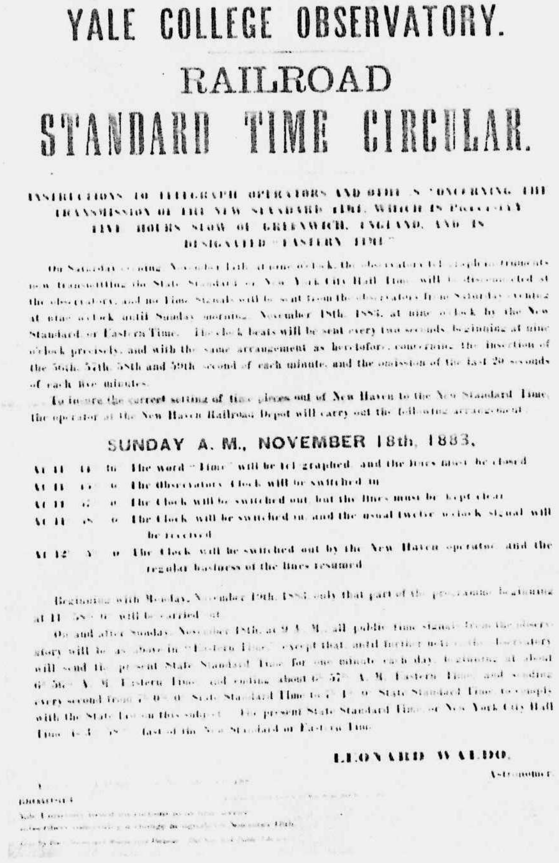
[74] Editorial page, *The New York Times,* November 18, 1883, p. 8, col. 1.



YALE COLLEGE OBSERVATORY.

RAILROAD

STANDARD TIME CIRCULAR.

SUNDAY A. M., NOVEMBER 18th, 1883.

LEONARD WALDO,

Astronomer.

FIG. 2.—Observatory notice announcing the change to standard time. (Courtesy the New York Public Library—W. F. Allen Collection.)

gor's mayor vetoed the time for his city.[75] Some clergy argued that the local time of their region was God's time and that the new time was a falsehood—it was not based directly on the Earth's rotation.[76] And, familiar today because it has been cited as indirect evidence of the public's fundamental mistrust of the railroad companies' power during this era, there was a tongue-in-cheek article in an Indianapolis newspaper: "The sun is no longer to boss the job. People . . . must eat, sleep and work . . . by railroad time. . . . People will have to marry by railroad time. . . . Ministers will be required to preach by railroad time. . . . Banks will open and close by railroad time; notes will be paid or protested by railroad time."[77]

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[75] *The Railway Age* 8 (November 29, 1883): 753, began an editorial with "A Dogberry who holds the office of mayor," alluding to the stupid public official in *Much Ado about Nothing*. Riegel, "Standard Time in the United States" (n. 1 above), p. 87, continues this pejorative identification. Mayor Cummings's veto was lampooned. Too lengthy to be given here, it ends with: "remember what Leonidas was at Thermopylae to Greece, what Bruce was to Scotland, what all great leaders have been to the liberties of the people in all ages, he is to the town clocks of Bangor!" See the various editorials and brief articles in the Bangor *Daily Whig and Courier*, November 13–November 29, 1883.

Explanations for the opposition have not been very satisfactory. For example, those ministers residing in Chicago or New York or Philadelphia did not denounce the new time, so it is difficult to accept resentment of the loss of traditional values as the motivation for resistance. Public mistrust of the railroads' power has also been suggested. Yet, in those regions where the extant local time changed by modest amounts, no written denunciations of the companies have been found. Given the history of strong antirailroad feelings during these decades and the visibility of the time issue to the public, one would have expected such opposition everywhere.

There is a more likely explanation in the one circumstance common to this opposition: It existed along the boundaries between the zones, with the strongest, longest-lasting opposition concentrated in the eastern regions of the two major zones.[78] (See fig. 3.) Allen said that his plan would lead to clock times such that "the greatest discrepancy between local and standard time can be but about thirty minutes."[79]

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[76] The Allen Papers (n. 57 above) contain a news clipping (incorrectly) ascribed to the December 6, 1883, Boston *Herald* regarding a city clergyman, Rev. W. B. Wright. See also Corliss (n. 64 above), p. 16. F. W. Allen, "The Adoption of Standard Time in 1883" (n. 1 above), pp. 54–55, mentions ministers in Des Moines, Charleston, and Tennessee. "Standard time is God's time!" was argued eighty years later by a congressman during daylight-saving time debates. *Hearings on Uniform Time*, U.S. House of Representatives, 88th Cong., 2d sess. (Washington, D.C., 1964), p. 88.

[77] Editors, "Railroad Time," *Indianapolis Daily Sentinel*, November 21, 1883, p. 4, col. 2. Two days earlier a humorous discussion of the change—causing everything to be sixteen minutes slow constantly—had appeared (p. 8, col. 3); and on November 16 a similar note reminding people of the imminent change had been printed (p. 8, col. 2).

[78] See Dowd's map in his *System of Time Standards Illustrated with Map* (Saratoga Springs, N.Y., 1885), 8 pp. Dowd wrote, "as a rule, places located within about two and a half degrees [10 minutes] either way from this [30-minute] border line, disregard Standard time for home use, and still retain their old diverse local times."

[79] Allen, "Report on Standard Time" (n. 63 above), p. 691. Also, *Travelers' Guide* 15, May 1883, p. xxxi: "the difference between local and standard time averaging about fifteen minutes, and not in any case to exceed about thirty minutes." Also, ibid., September 1883, p. xxxi, April 1883, p. xxxii. Amusingly, Allen's son wrote, over sixty-five years later, "One of the theories which dominated Mr. Allen's plan was that any

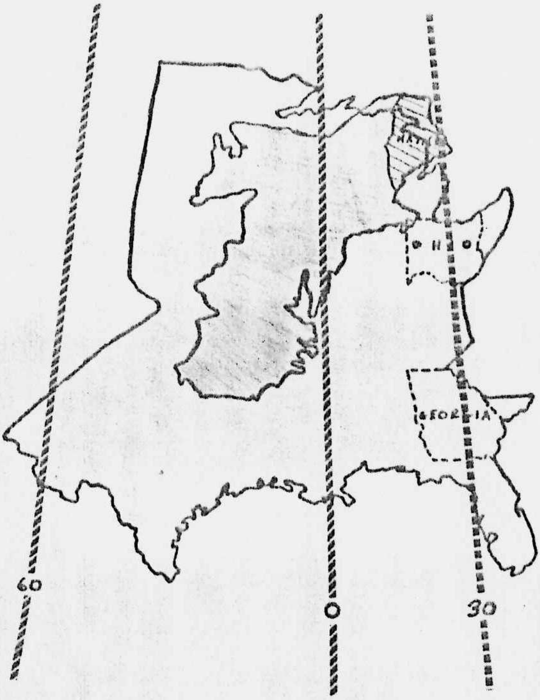

FIG. 3.—Citizen opposition to the railroads' time system was concentrated in Maine, Ohio, and Georgia. This map by the author overlays the two major zones; the meridians shown are minutes from the (Greenwich) time-defining meridian. See Bartky and Harrison (n. 2), p. 47, for a similar analysis and map of zone-based opposition to daylight-saving time.

For this country's new eastern zone, however, standard time actually ranged from thirty-two minutes slow on the zone's eastern edge and thirty-eight minutes fast on its western edge, compared with the local times. In the central zone standard time was up to forty-five minutes slow and up to sixty-six minutes fast. These differences scarcely would have mattered to anyone except for *one* significant change: People at the extremes of the zones perceived a change in sunlight.[80]

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large section of the population would live contentedly in an area where the time was fixed with a difference of not more than *forty or forty-five minutes* from sun time" [emphasis added]. John S. Allen, *Standard Time in America* (n. 1 above), p. 5.

[80] "Hard on the workingman by changing day into night" (Riegel, "Standard Time in the United States" [n. 1 above], p. 87); also, F. W. Allen, "The Adoption of Standard Time in 1883" (n. 1 above), pp. 58–59.

Consider Savannah. Allen's plan assigned it, like all of Georgia, to the central zone. If central time were adopted, Savannah's sun would set over thirty minutes earlier than people there were used to—at the times shown in table 1. Citizens tried the new time but then rejected it.[81] People in Maine cities like Bangor and Bath perceived similar early sunsets in mid-November 1883. Citizens in Ohio cities balked at the change. Detroit and Port Huron, Michigan, residents denounced the new system and stayed with local time.

Afterward

In December 1884 Allen reported that all railroads but two short lines around Pittsburgh were using standard railway time. To achieve this level of acceptance, Allen had extended the Pacific zone eastward to Deming, New Mexico, and El Paso, Texas. He also created an anomaly: three time zones touched in west Texas. After January 1, 1887, when Pittsburgh and its railroads adopted eastern time, Allen reported that his railroad task was finished.[82]

For several years Allen and others worked to have more jurisdictions adopt standard railway time. Maine adopted zone time in 1887 through such efforts, and Ohio followed in 1893. But other states never did. In the early 20th century, a well-known astronomer described the effects of this country's "mixed" system: "Many people, and even schools, persist in creating confusion by using local time. In some cities one has to allow a margin of twenty minutes in appointments because of the uncertainties due to this chaotic state."[83] This mixed system persisted more than a decade longer.[84]

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[81] Allen then tried to get the state of Georgia to adopt standard time, *PAMS* 5 (1888): 159. He was unsuccessful, and we have the 1889 opinion of a Georgia court: "The only standard of time . . . recognized by the laws of Georgia is the meridian of the sun . . . an arbitrary and artificial standard of time, fixed by persons in a certain line of business, can not be substituted at will in a certain locality for the standard recognized by the law." See "The Present Status of the Use of Standard Time," *Publications of the United States Naval Observatory* 4 (appendix) (1905): G15.

[82] Editors, "Standard Time and Measures," *Science* 9 (1887): 7. Also, *PAMS* 5 (1888): 159.

[83] Moulton, "Time" (n. 64 above), p. 399.

[84] Haines, *Efficient Railway Operation* (n. 19 above), p. 389, writing just before World War I, recalled "strenuous opposition in communities whose local time differed materially from the railroad standard," stating that "to this day, the system has been legally established in but four [actually, around fifteen] states of the Union." Doris C. Doane, *Time Changes in the U.S.A.*, American Federation of Astrologers (Tempe, Ariz., 1966), gives tables that show most states adopting standard railway time on November 18, 1883. This depiction is likely a misunderstanding of the difference between custom and law. Also, it is probable that a state's statutes allowed for local option—see, e.g.,

TABLE 1

SUNSET IN SAVANNAH, GEORGIA

Date	Local Time	Railway Time
November 1	5:10	4:35
December 1	4:55	4:20
January 1	5:07	4:31
February 1	5:34	4:58
March 1	5:58	5:22
April 1	6:20	5:44
May 1	6:40	6:05
June 1	7:01	6:26
July 1	7:10	6:35
August 1	6:57	6:22
September 1	6:24	5:49
October 1	5:45	5:09

SOURCE.—U.S. Naval Observatory, Nautical Almanac Office publications.

Standard railway time, an unofficial time and regional in nature, ended officially at 2:00 A.M. on Sunday, March 18, 1918, when the provisions of "An act to save daylight and to provide standard time for the United States" became effective. We can well imagine the controversy generated over the next months.[85]

The adoption of zones for purposes other than railroad needs led to major shifts in the boundaries; in particular, the "bisection" of cities by the railroad zones was discontinued. Thoughtful and well-articulated criteria were developed by the Interstate Commerce Commission and used to define the boundaries.[86] Since these new boundaries posed problems for the railroads, a system of "operating exceptions" was established: Roads were allowed to carry the time from the adjacent zone across the boundary to some convenient terminating point. In this manner, the traveler could use the time of the zone, but rail operations—a specialized need—would continue as before. This system is still used.[87]

Howse, *Greenwich Time* (n. 4 above), p. 126, regarding Detroit's difficulties. Also, "Dividing Points of the Standard Time Sections of the United States and Canada," *Measurement of Time and Tests of Timepieces*, National Bureau of Standards Circular no. 51 (Washington, D.C., 1914), pp. 323–30.

[85] The federal zones were radically different from the railroad ones in many places, being based rather closely on the hour difference theory. So some areas, including parts of Florida, Georgia, and Ohio, were advanced *two* hours by the combined effects of a new zone and daylight-saving time.

[86] 51 I.C.C. 273 (1918). The record since this date is voluminous.

[87] I am indebted to Robert Ross, Office of the General Counsel, Department of Transportation, for this information.

The final period of a special railroad time that affected the public lasted from 1920 to 1967: The railroads kept and displayed standard time—except during World War II—as many cities and counties were keeping daylight-saving time.[88] Federal law ended the disorder.

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[88] For the official history—1918 and beyond—see *Standard Time in the United States, a History of Standard and Daylight Saving Time in the United States and an Analysis of the Related Laws,* Department of Transportation (Washington, D.C., 1970), 27 pp.; also, Bartky and Harrison, "Standard and Daylight-Saving Time" (n. 2 above). The superseding of all local statutes by the federal government led at once to near-total time uniformity—as we have seen, a very rare situation in the United States.

"Society Improved the Way You Can Improve a Dynamo": Charles P. Steinmetz and the Politics of Efficiency

JOHN M. JORDAN

In the early decades of this century, when American technological development contributed to one wing of the Progressive movement a vocabulary of reform, Charles Proteus Steinmetz occupied a special position relevant to both technology and reform. As the second-best-known electrical scientist in the country after Thomas Edison, Steinmetz came to symbolize the era's spirit of technical achievement, partially through his development of a spectacular lightning generator. As an employee of the most powerful electrical-equipment firm in the country, he generalized from his experiences to devise a social theory calling for the replacement of America's elected national government by corporate functionaries. As a non-Marxian socialist for his entire adult life, Steinmetz challenged class-based radicalism with a reformist politics that he felt could overcome class antagonism. So perceptive a cultural radical as Randolph Bourne found Steinmetz's corporatist political reformulation compelling.

The means by which a technical expert came to play such a sustained part in social and political thought are primarily linguistic. And no single word was more vital to Steinmetz's eminence than the word "efficiency." It provided the semantic adhesive that bonded all of his utterances about state and society. Efficiency, of course, is a simple mathematical relationship between parts of a machine process. Was society therefore a machine? It would seem so; Steinmetz wrote consistently and vigorously in this metaphorical light.[1] When society is a

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Dr. Jordan recently received his Ph.D. from the University of Michigan and is completing a book on engineering and American political discourse. He thanks the readers of the essay—David Hollinger, Ronald Kline, David Nichols, John Staudenmaier, James Turner, and George Wise—and the *Technology and Culture* referees.

[1] For a helpful discussion of technological metaphor, see D. O. Edge, "Technological Metaphor," in *Meaning and Control: Essays in Social Aspects of Science and Technology*, ed. D. O. Edge and J. H. Wolfe (London, 1973), pp. 31–59.

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for *Harper's* the usefulness of observatory time in urban centers for the "security of commerce and the punctuality of business."[50]

The precise extent of time awareness in other spheres of antebellum American culture still requires extensive study. The foregoing examples suggest that Americans were prepared for a faster-paced life even before the railroads could provide it.[51] In the Bond episode from New England, though, lie some of the clearest details of how the 19th-century revolutions in transportation and communications fundamentally altered the rhythm of life and contributed to a heightened sense of time.

The railroad and the telegraph powerfully accelerated a process of synchronization of activities that had actually begun in the late Middle Ages, when both the mechanical clock and urban capitalist economy were invented. The bond between clocks and capitalism, cemented at that early date, strengthened during the 19th century, as time became an important factor in the quickening pace of commerce and industry.

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[50] Elias Loomis, "Astronomical Observatories in the United States," *Harper's New Monthly Magazine* 13 (June 1856): 51–52.

[51] The emphasis on punctual scheduled activities occurred slightly earlier in England than in the United States, but how much influence the British precedent had across the Atlantic has yet to be determined. Scheduled stagecoach runs, e.g., raised the time consciousness of Britons in the pre-railway age. And the British upper classes after about 1750 structured their daily existence according to a social timetable that closely specified when to eat, work, dress, visit, and so on. Landes, *Revolution in Time* (n. 1 above), p. 228; and Thrift, "Owners Time and Own Time" (n. 3 above), pp. 62–63.